AN125

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IFAS Extension

Water For Poultry [1]

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Most of the standards that we are attempting to apply to animal drinking water are taken from those set for humans, and even they have a rather short history. The Public Health Service Act of 1962 was some of the first human water quality legislation and dealt only with sanitary surveys of water involved in interstate commerce. It was the Safe Drinking Water Act of 1974 that made the Environmental Protection Agency responsible for establishing national drinking water regulations, overseeing the safety of public water systems and protecting underground water sources against contamination.

Problems with Measurement Standards for Poultry-Quality Water

Some of the measurement characteristics commonly used to define human potable water quality, such as pH, hardness and electrical conductivity, are not very useful in predicting poultry performance. Hydrogen ion concentration (pH) tells nothing about the solution's buffering capacity or the identity and amount of individual ions. Hardness indicates the tendency to precipitate soap or to form scale on heated surfaces. What one really needs to know is the individual concentrations of calcium and/or magnesium, the principal contributors to this measurement. Electrical conductivity provides a measure of total mineral load and no individual ion analysis.

A number of popular articles have been written about water quality for poultry, yet very few research papers dealing with the subject could be found in the scientific journals during the past ten years. Clearly, we have much work ahead to develop an accurate specialized tolerance profile for poultry. The first step towards this goal was made by a National Academy of Sciences subcommittee in 1974 with their review booklet entitled "Nutrients and Toxic Substances in Water for Livestock and Poultry." That publication summarized the literature before 1974 and indicated that a total soluble salt level of 1000 ppm or less would present no problem to livestock or poultry. It also provides recommended limits for several other potentially toxic substances (As, Cd, Cr, Co, Cu, F, Pb, Hg, Ni, $N0_2$, $N0_3$, V and Zn). Many of these are heavy metals and would not be a problem except in special situations. Several of the popular articles carry compilations of "good, maximum, tolerable or threshold" values for poultry water supplies. Most of these hinge on human standards, the NRC publication or a combination of other tables and are, overall, quite variable. For instance, iron tolerances ranged from 0 to 50 ppm, nitrates from 20 to 200 ppm, sulfates from 200 to

1. This document is AN125, one of a series of the Animal Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date February 2002. Reviewed November 2008. Visit the EDIS Web Site at http://edis.ifas.ufl.edu.
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1000 ppm and sodium from 50 to 1000 ppm. Some of this variation is due to the standard pitfall of trying to consider each element individually when there are many interactions that influence their tolerance, but a paucity of research data is the biggest culprit.

Cooling Water to Combat Heat Stress

Most of the recent research effort with water has centered around heat stress problems. Adding sodium chloride, potassium chloride, potassium sulfate or carbon dioxide to broiler drinking water has been shown to increase gain slightly and lower body temperature (Teeter, 1988). Most of this effect is probably attributable to the resulting increased water intake. One report of broiler work also shows a benefit in daily gain from providing cool drinking water (55 degrees F). Work at the University of Florida with cooling hens' drinking water to 50 or 70 degrees during hot daylight hours did not improve performance other than the shell and interior quality of eggs. Artificially refrigerating water for poultry during the summer is probably not economically feasible, but there are some adjustments that can be made. Those include insulating water pipes or installing them underground rather than near the roof as is often done. Lowering the temperature just a few degrees could make a critical difference.

Water Hardness

Hardness is primarily a measure of calcium and magnesium content, so Atteh and Leeson (1983) examined the effect of adding these to broiler drinking water. They found that up to 100 ppm magnesium significantly improved feed efficiency but increased the incidence of swollen hocks and shortened tibia. Up to 100 ppm of calcium had no effect. Work at the University of Florida sponsored by the Southeastern Poultry and Egg Association found significant decreases of water consumption and egg production when 2000 ppm calcium was provided in lactate form through the drinking water. These drops were probably due to the taste factor; however, egg shell quality was significantly improved even when the diet contained 3.75% calcium. When hard water is a problem in proper equipment operation, it can easily be “softened” with commercial water treatment equipment. Most of the processes exchange the sodium ion from sodium chloride for other minerals present. Roush and Mylet (1986) studied the influence of softening on hens over a 308-day period. The process was concluded to improve performance of birds consuming diets with no added salt. No benefit was shown when diets were supplemented with .35 or .70% salt. It is recommended that the sodium of softened water be monitored because it may influence the amounts of fish meal, defluorinated phosphate, bakery products or salt used by your nutritionist.

Chlorinating to Eliminate Bacterial Contamination

Bacterial contamination can be a pesky problem for both the humans and chickens that drink the water. Again, there is little research with animals, but most everyone agrees that there should be no fecal coliform contamination. The first step towards eliminating contamination is to determine if the source is the well or the distribution system. For a properly sealed and located well, treatment of the well cavity with a chlorine source such as sodium hypochlorite may remedy the problems. If continuous chlorination seems necessary, it should be applied gradually. Most people tend to be very cautious, and wisely so, about starting this procedure for fear of the strong odor or taste causing reduced performance. Between two and five ppm of residual chlorine is recommended. Start at the lower concentration and increase it until control is satisfactory. Since water intake is the most sensitive criteria, it should be monitored during this process for signs of intolerance. We have completed trials with sodium hypochlorite to help answer the question “How much is too much?” Body weight of broiler chicks was not significantly reduced by 150 ppm chloride from sodium hypochlorite, while daily water intake dropped at between 10 and 100 ppm chloride. Egg production of White Leghorns was not significantly affected by 50 and 100 ppm chloride, but water consumption was affected adversely at 50 ppm. We think this demonstrates a good safety margin above the upper recommendation of five ppm.

Contamination from Pesticides and Organic Chemicals

What about pesticide and organic chemical contamination? Since the Safe Drinking Water Act was passed, the improved sophistication of detection methods has allowed the discovery of organic chemicals in drinking water faster than their health significance could be assessed. By 1980 more than 700 volatile organic compounds had been identified. Pesticide contamination would not appear to be a widespread problem according to a 1983 publication by the Dow Chemical Company. They reported the results of a $5 million study by Cornell University in which virtually no pesticide residues could be found in water wells representing 63% of the U.S. rural population. The study did show that 29% of the homes had excess levels of coliforms and 25%, too much mercury. Almost 64% of those with problems (14 million) had high concentrations of two or more contaminants. In Michigan, a study of groundwater contamination causes showed that only three of 441 occurrences were due to pesticides. Improper storage and handling of gasoline accounted for 110, or 25%, of the total. Certainly these problems with agricultural chemicals and fuels do occur and, unfortunately, regulatory decisions are often more political than scientific, as the data above emphasize. Florida is leading in this area with new tank registration, containment and inspection laws.

Conclusion

The results of two rather extensive water quality surveys in Georgia (French et al., 1988) and Arkansas (Barton et al., 1987) offer some reassurance concerning poultry performance. Georgia's sampling was over 10 locations in each of five broiler companies with the conclusion that "with few exceptions, water in north Georgia is of excellent quality and is ideal for poultry and livestock production." The Arkansas study examined the water of 300 producers and looked for correlation between quality and bird performance. Twenty-five of the top and bottom producers were selected at each location by each company. Performance data from the previous year was the basis of selection and comparison. The conclusion was that water quality did not significantly contribute to top or bottom producer status, except in the case of nitrate.

Well, what usable information can we draw from this? It does not appear that water mineral load poses a serious problem to bird performance. It is much more likely to affect watering and washing equipment operation. Existing treatment technology can help with these aspects. In the future we may even find an advantage in adding sodium or potassium to drinking water before times of heat stress to increase water intake and help cool the bird.

Bacterial contamination can be a more persistent problem requiring some sleuthing to pin-point the source, but the standard treatment is chlorination with sodium hypochlorite or chlorine coupled with clean troughs and drinkers. Long-term correction may require well sealing or re-siting. The installation of septic tanks, spray fields and disposal pits also needs to include consideration of well location and the direction of underground water flow. When using water as a carrier of nutrients or medication, weather can be an important factor to affect calculations. Most drug dosages are formulated for an environmental temperature of 70 degrees F which may mean that we overmedicate by a factor of 50% in the summer and undertreat somewhat in winter. Young birds also drink more in relation to their body weight than older birds.

We can take heart from the on-farm surveys of our colleagues that say the water supply in the southeast U.S. is still in good condition overall.

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